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Title: High Amplitude Non Contact Acoustic Source for Defect Detection and 3-component Excitation

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High Amplitude Non Contact Acoustic Source for Defect Detection and 3-component Excitation

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March 11, 2014

Collaborators: Marcel Remillieux, TJ Ulrich, Brian Anderson



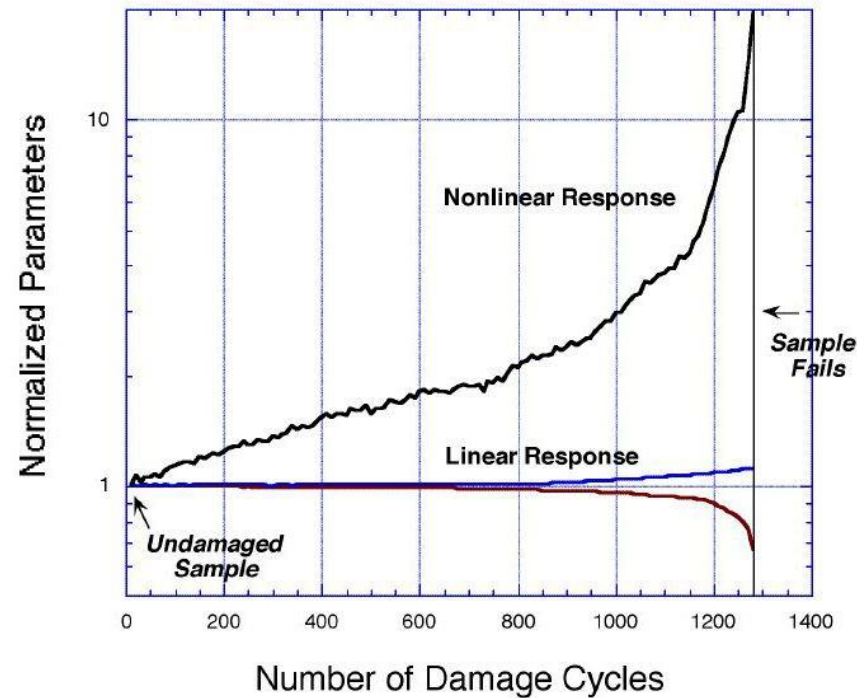
Outline

- Motivation
- Time Reversal basics
- Non contact source basics and first results
- 3 component excitation
- Path forward

Motivation

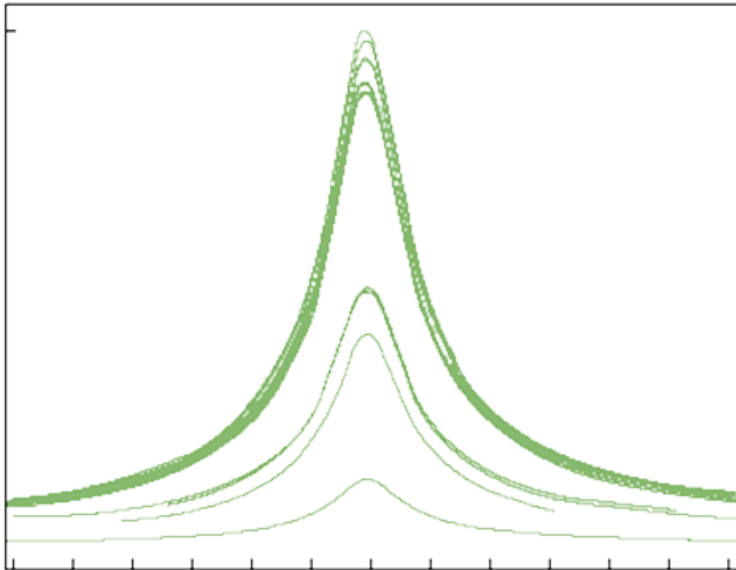
Nonlinear acoustics sensitivity to damage

Linear and Nonlinear Response
With Progressive Damage

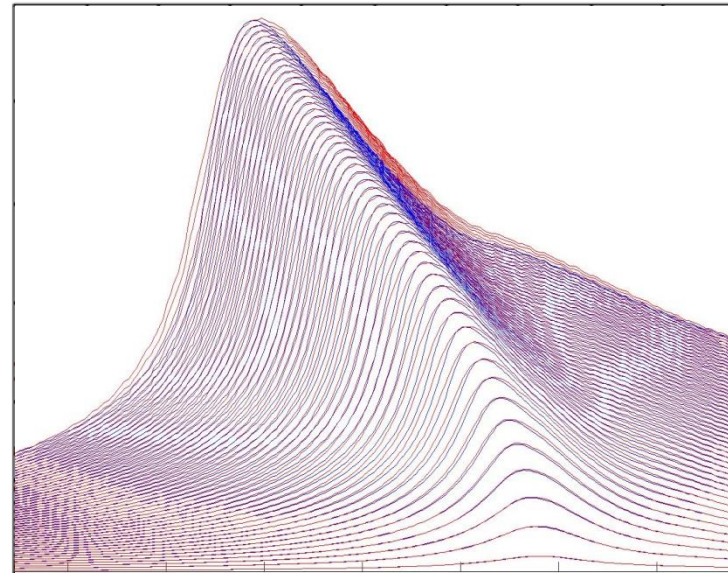


Nonlinear Signatures

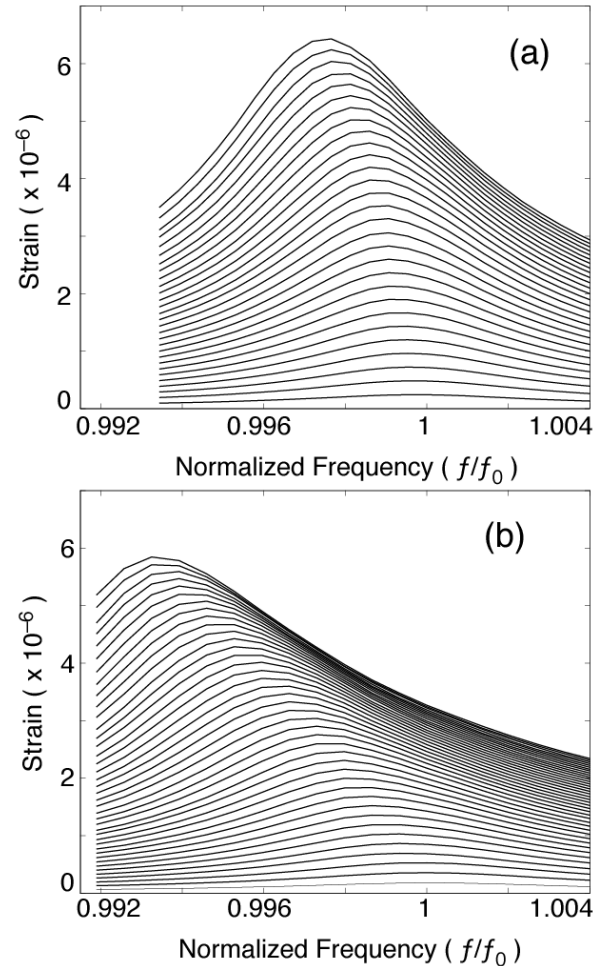
*Linear
(undamaged)*



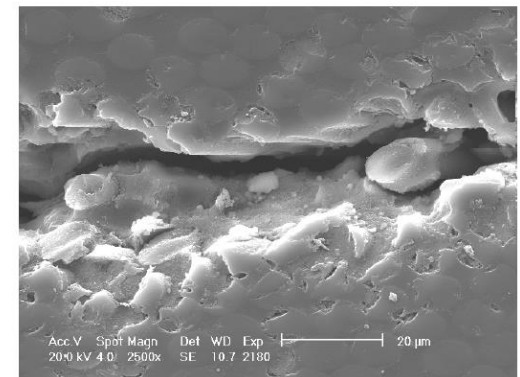
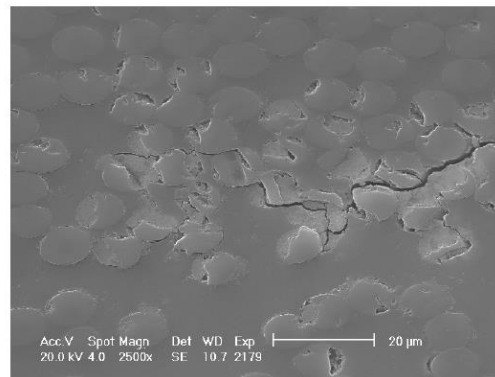
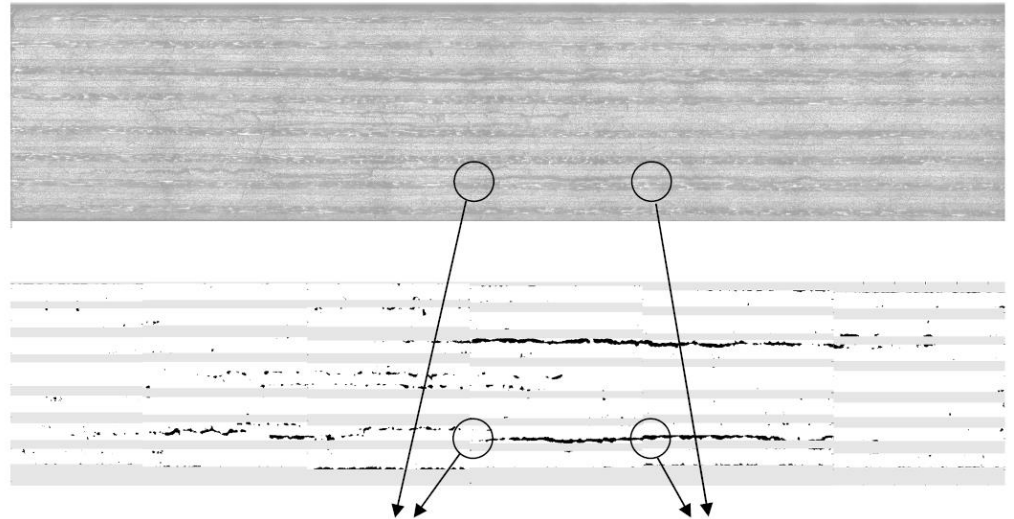
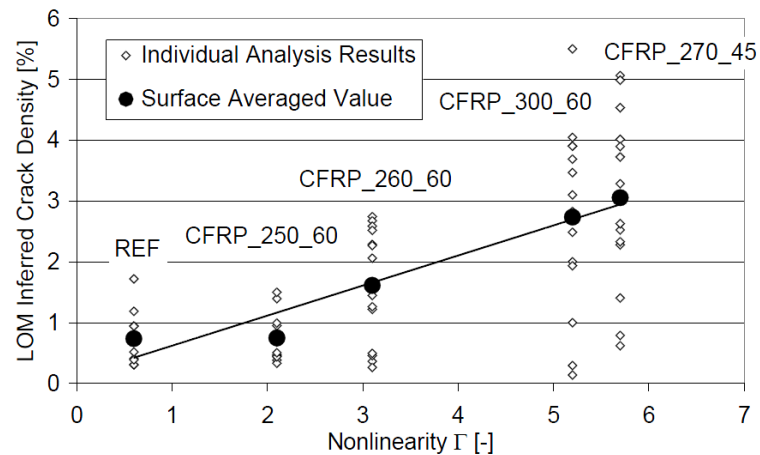
*Nonlinear
(damaged)*



Damage detection in concrete with nonlinear resonances



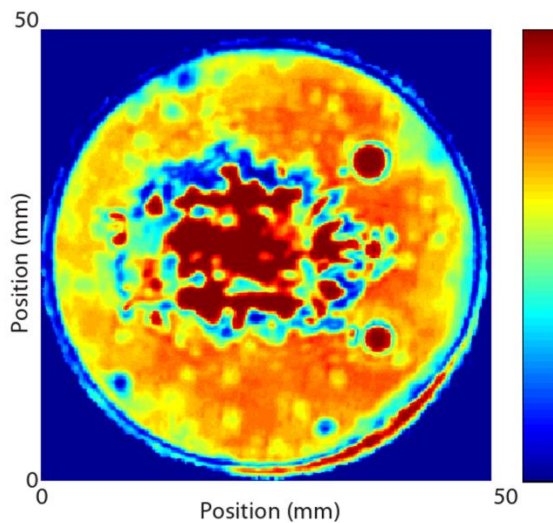
Correlation between damage and nonlinear parameter



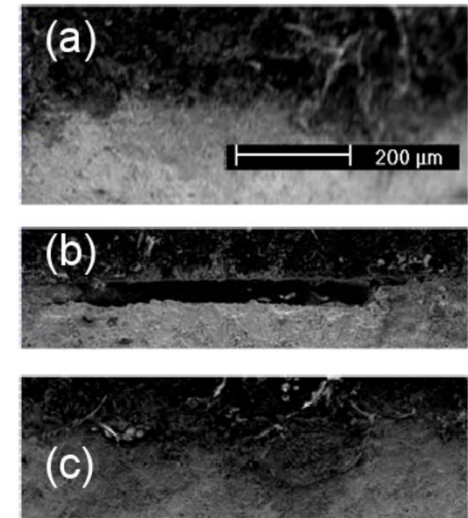
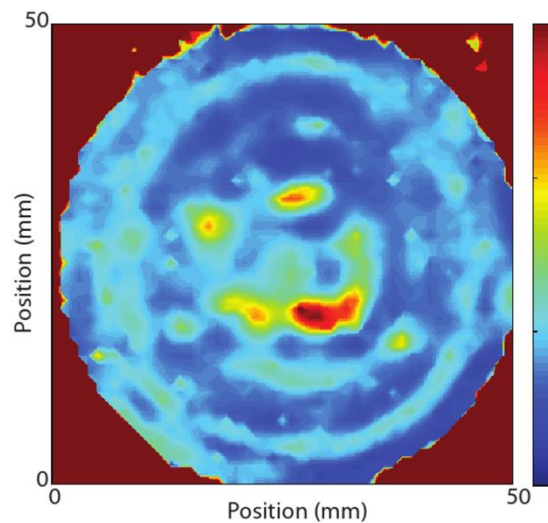
Interface Delamination



Linear

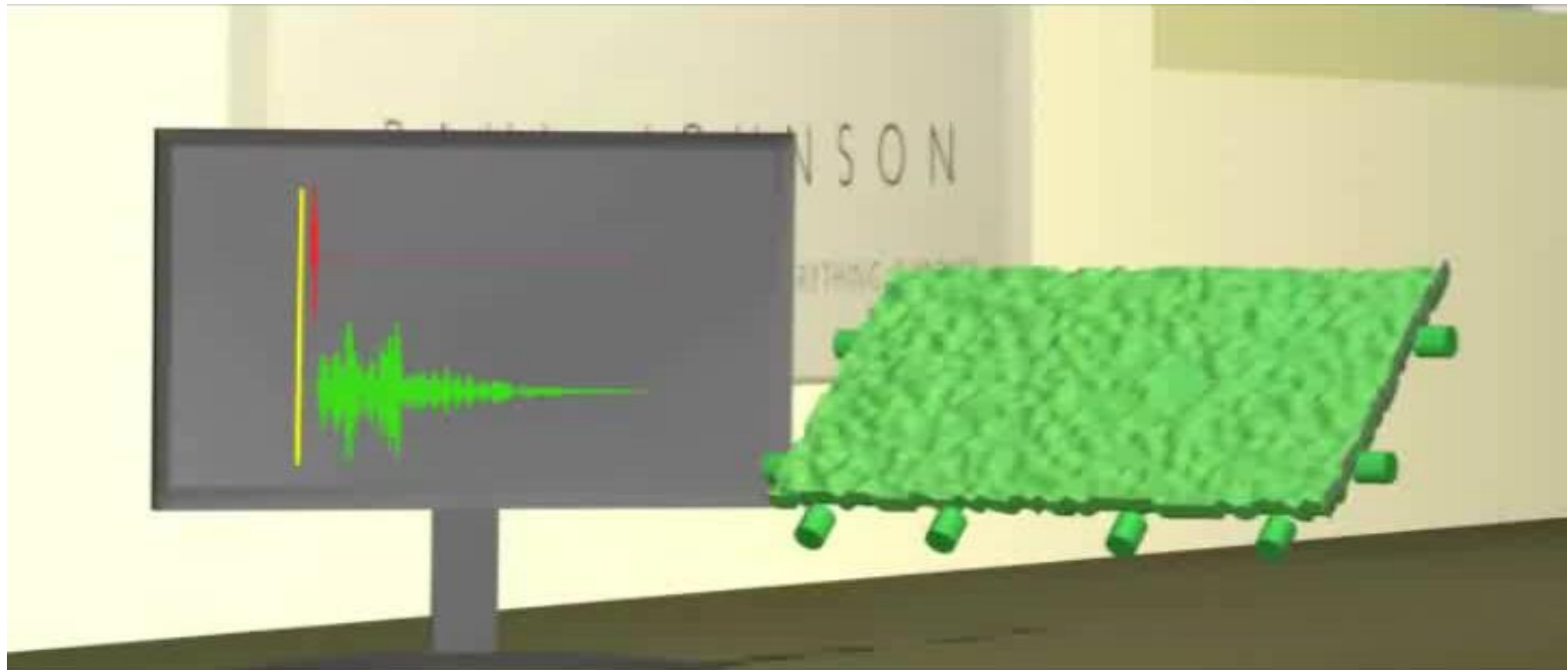


Non Linear



Time Reversal basics

Time Reversal

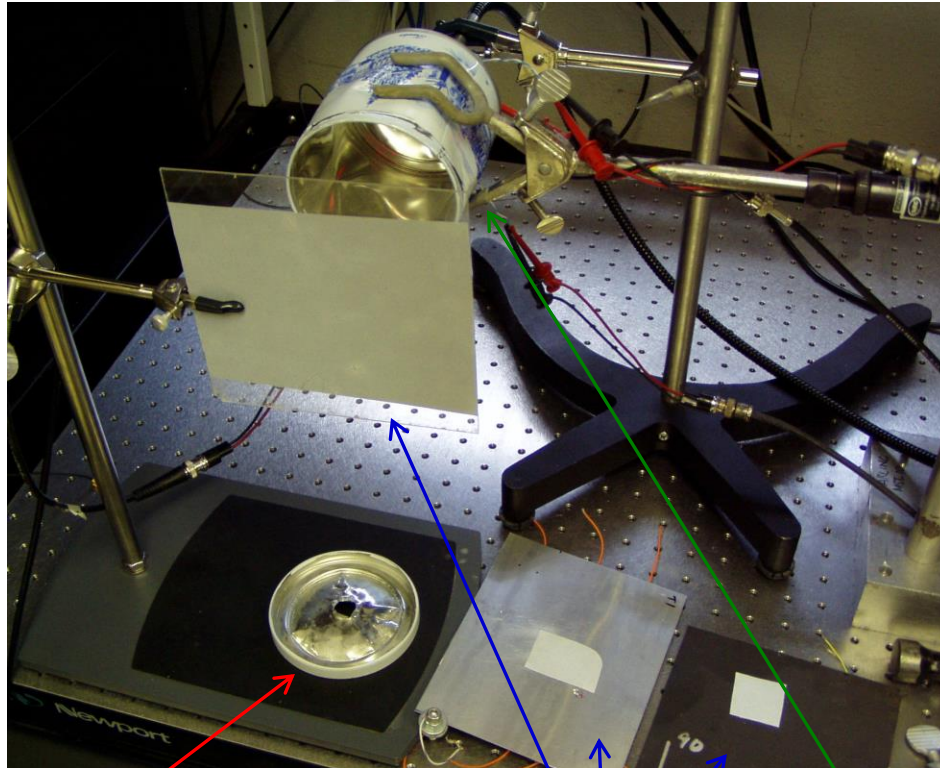


Non contact source basics and first results

Noncontact Source



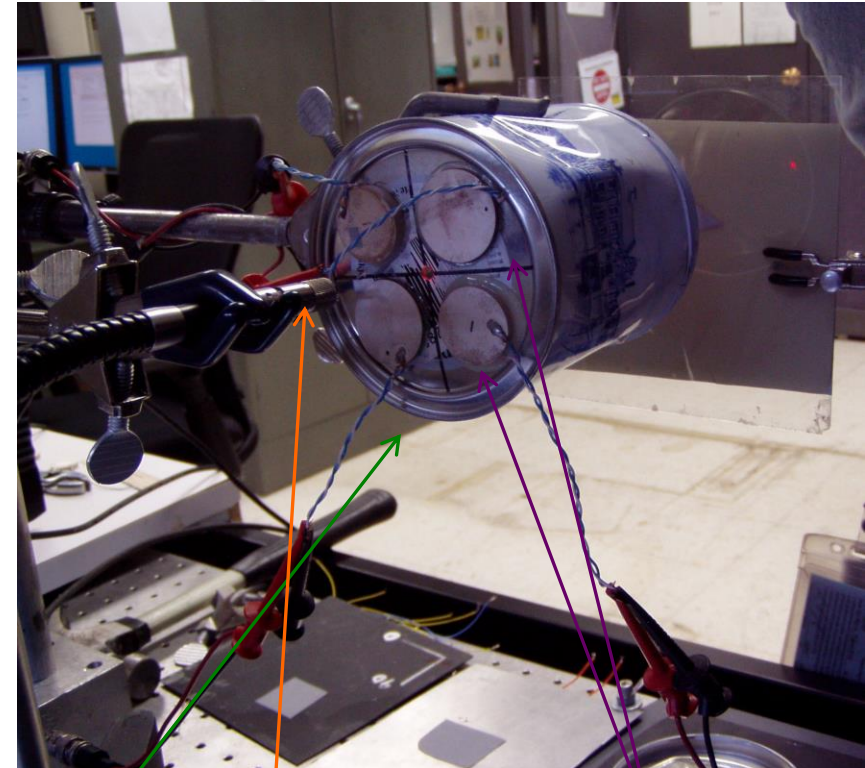
Prototype Candy Can ... or TRANS



Lid

Test Plates

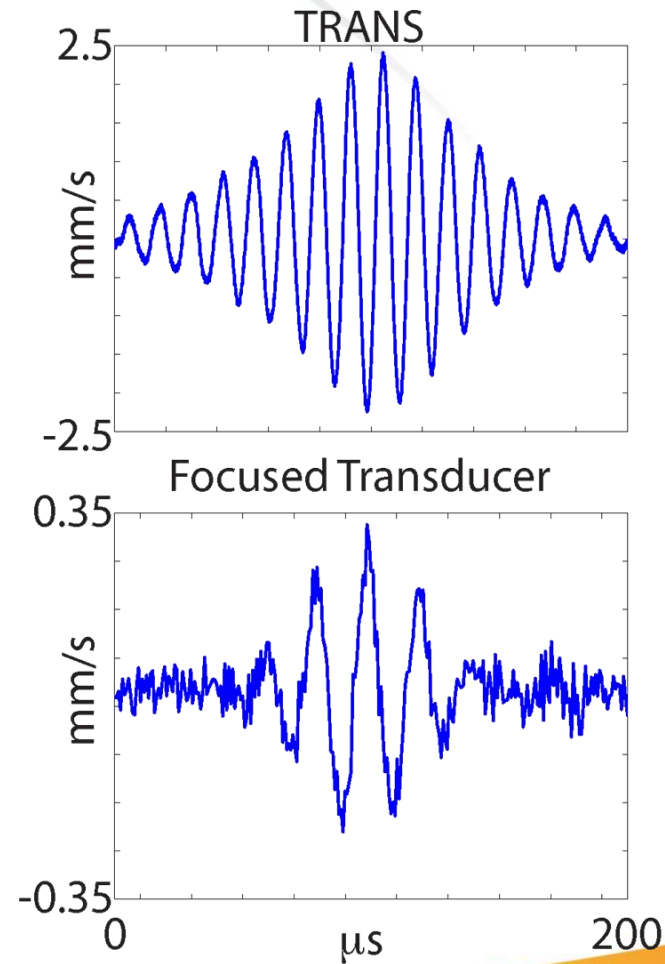
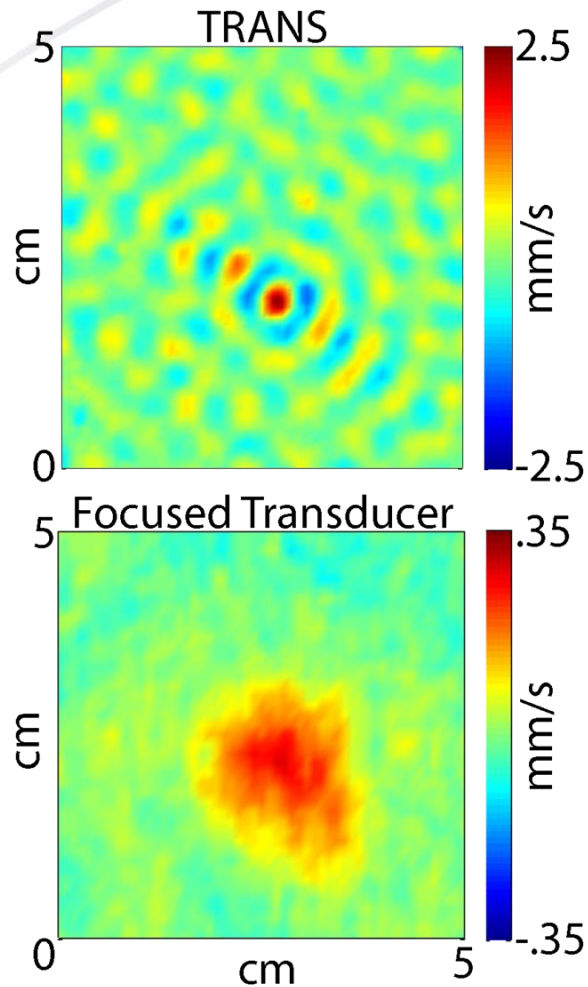
Cavity



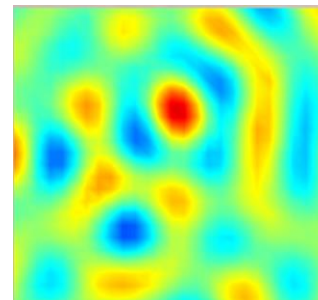
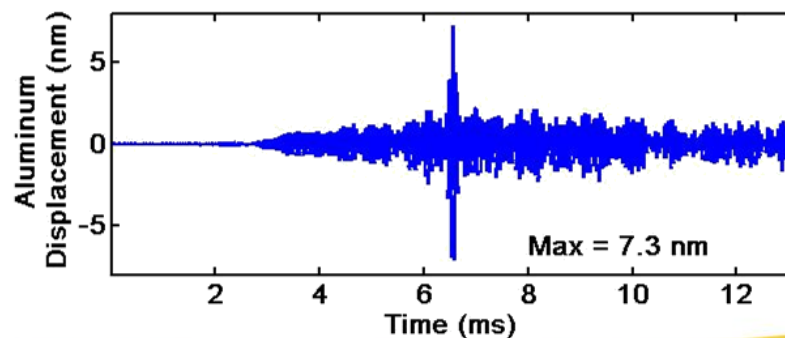
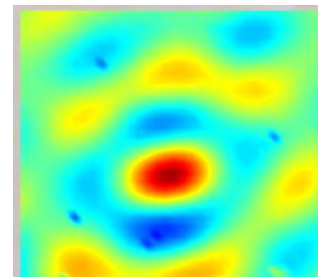
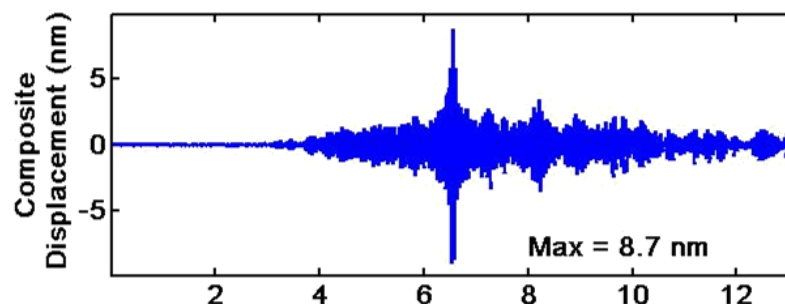
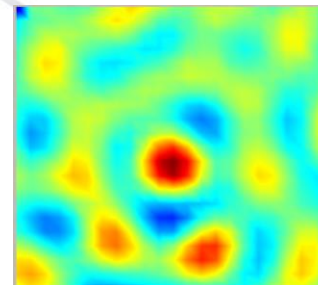
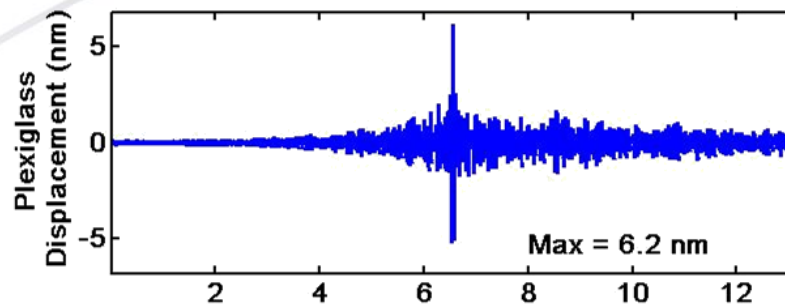
Fiber-optic LV

Transducers

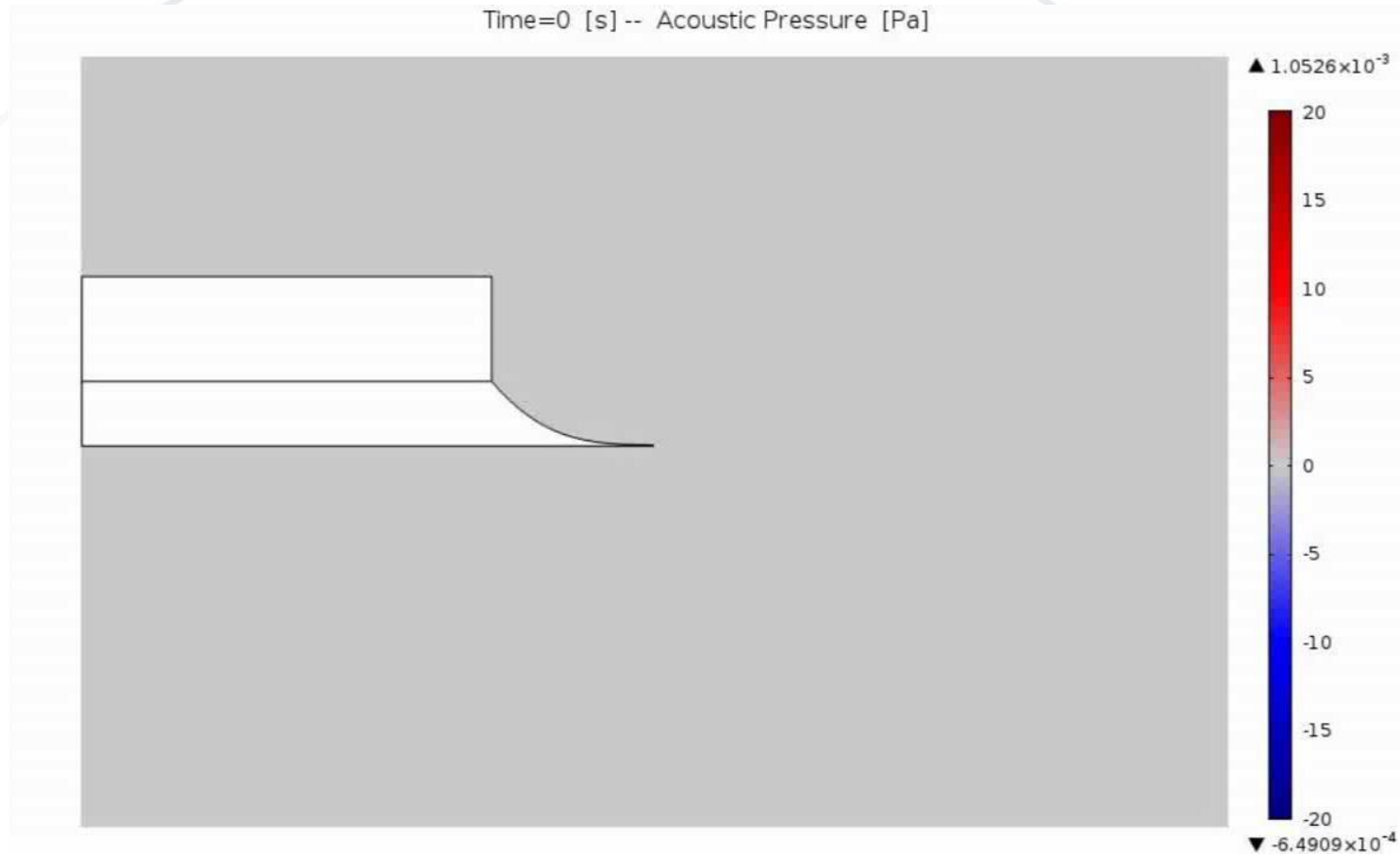
Head to Head: TRANS vs. FUT



Application to different materials

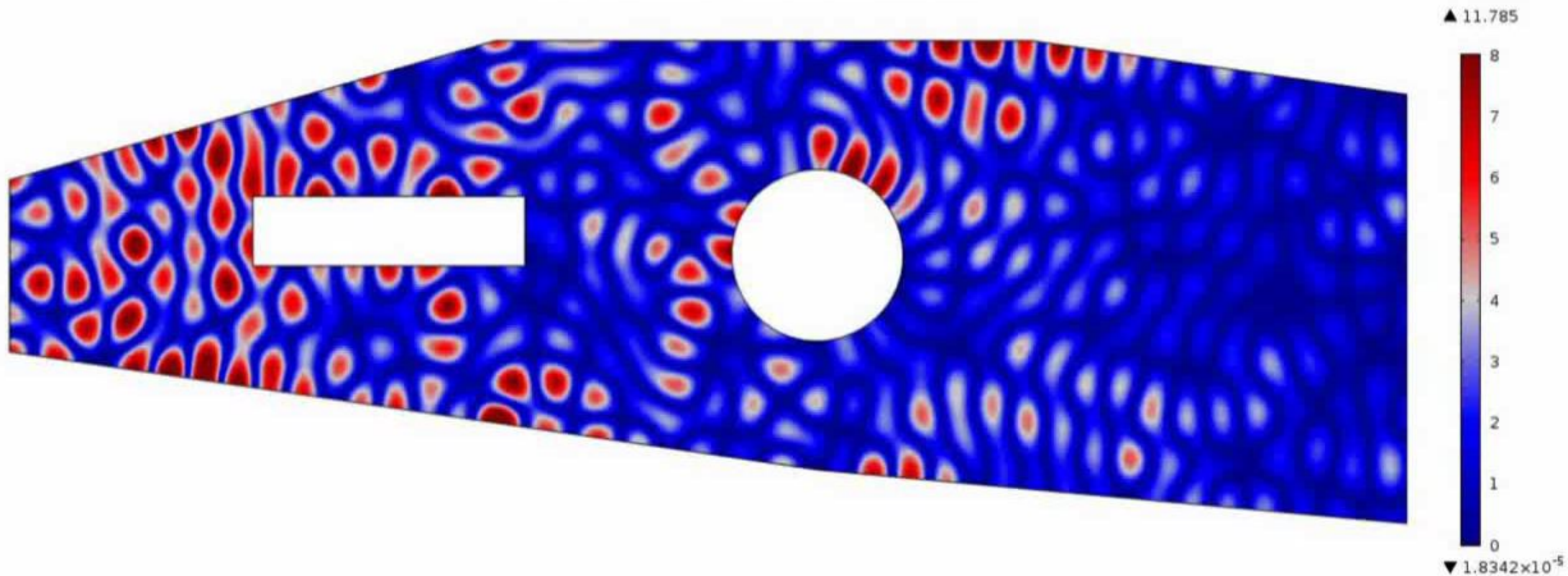


PZT/Air Coupling



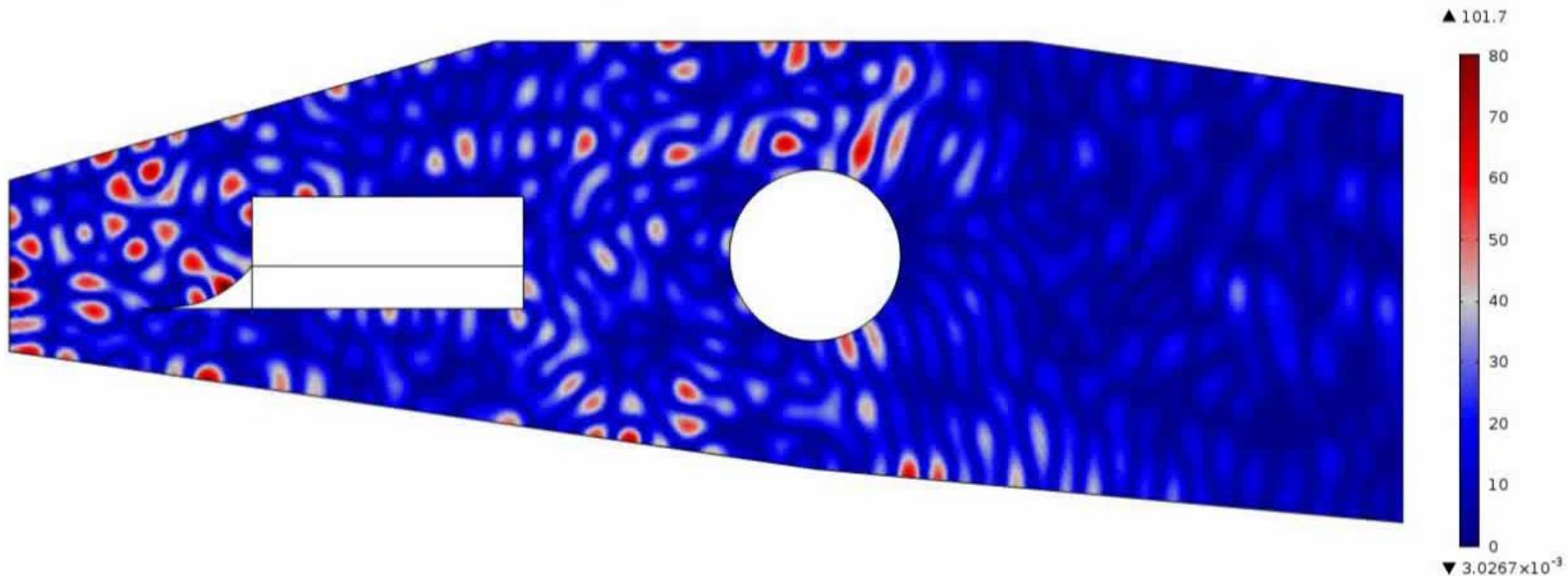
PZT/Air Coupling

Time=0.0029 [s] -- Acoustic Pressure [Pa]

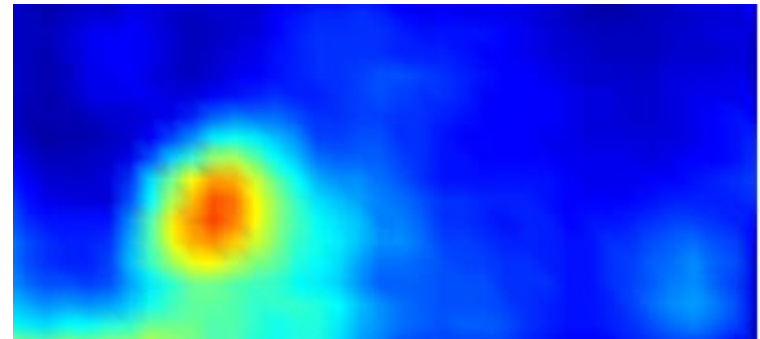
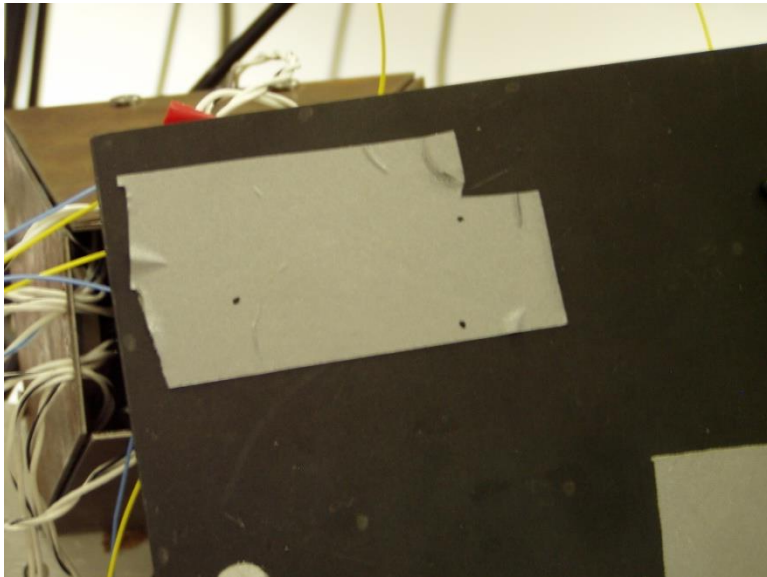


PZT/Air Coupling

Time=0.0029 [s] -- Acoustic Pressure [Pa]

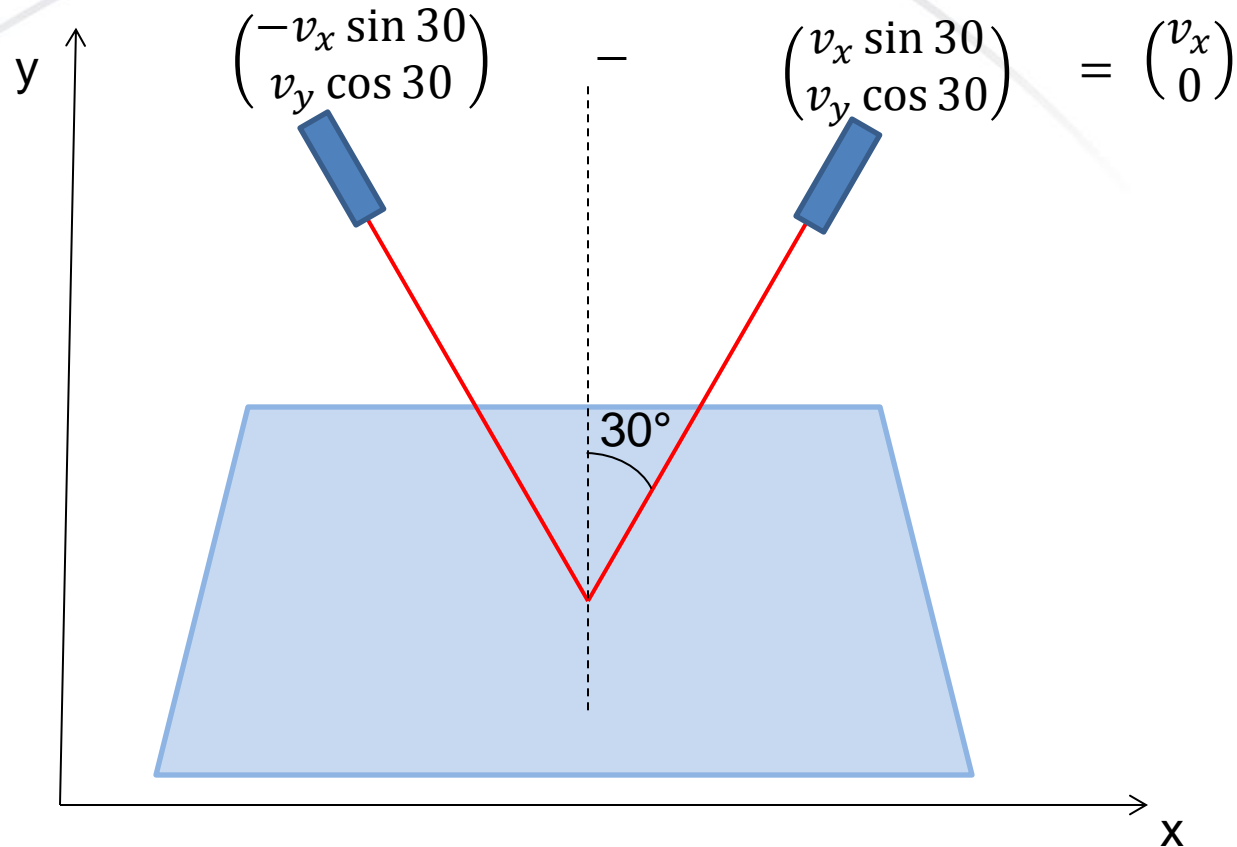


Non-Contact Nonlinear detection of delamination

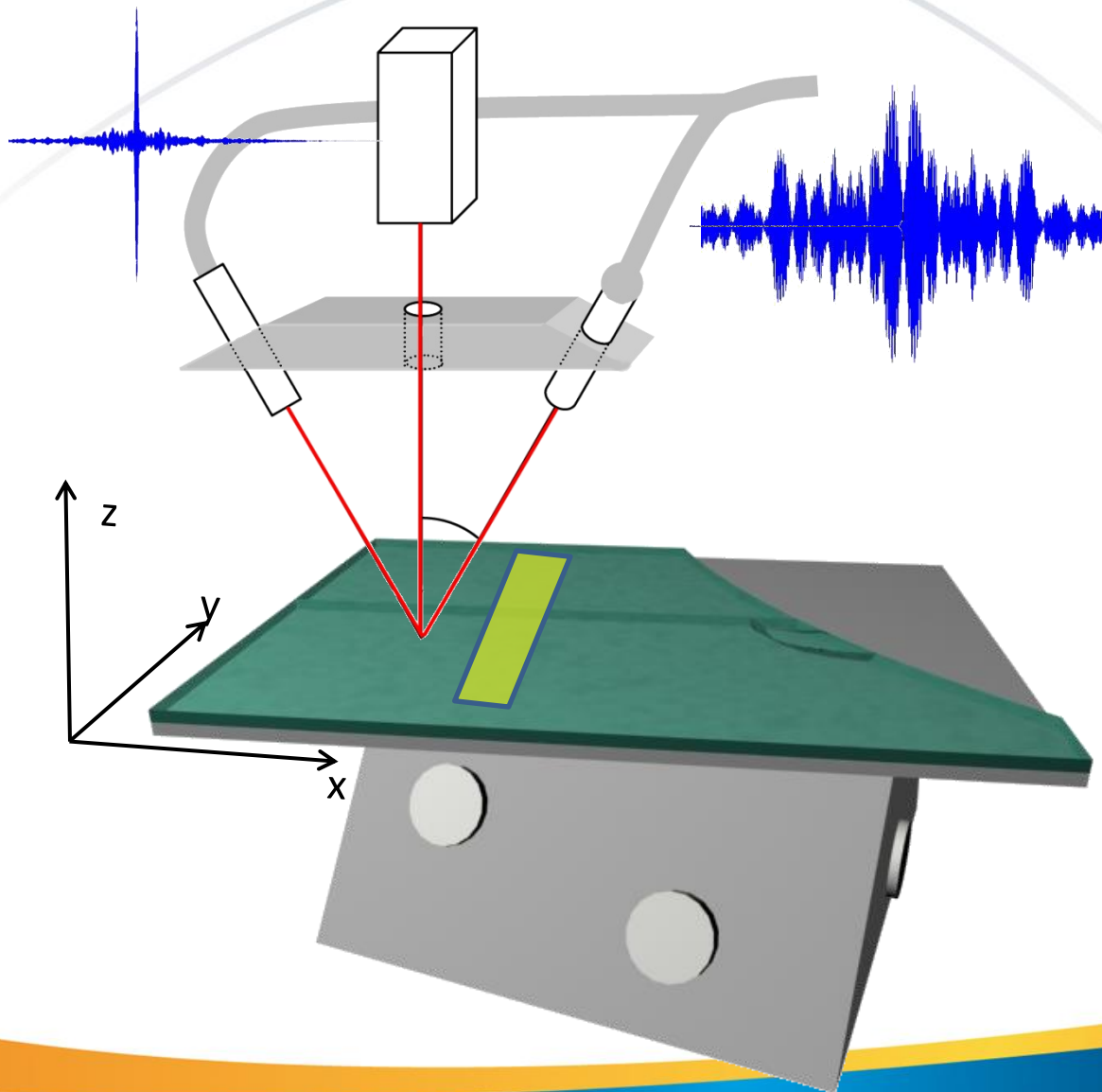


3 component excitation

Measuring In-Plane components



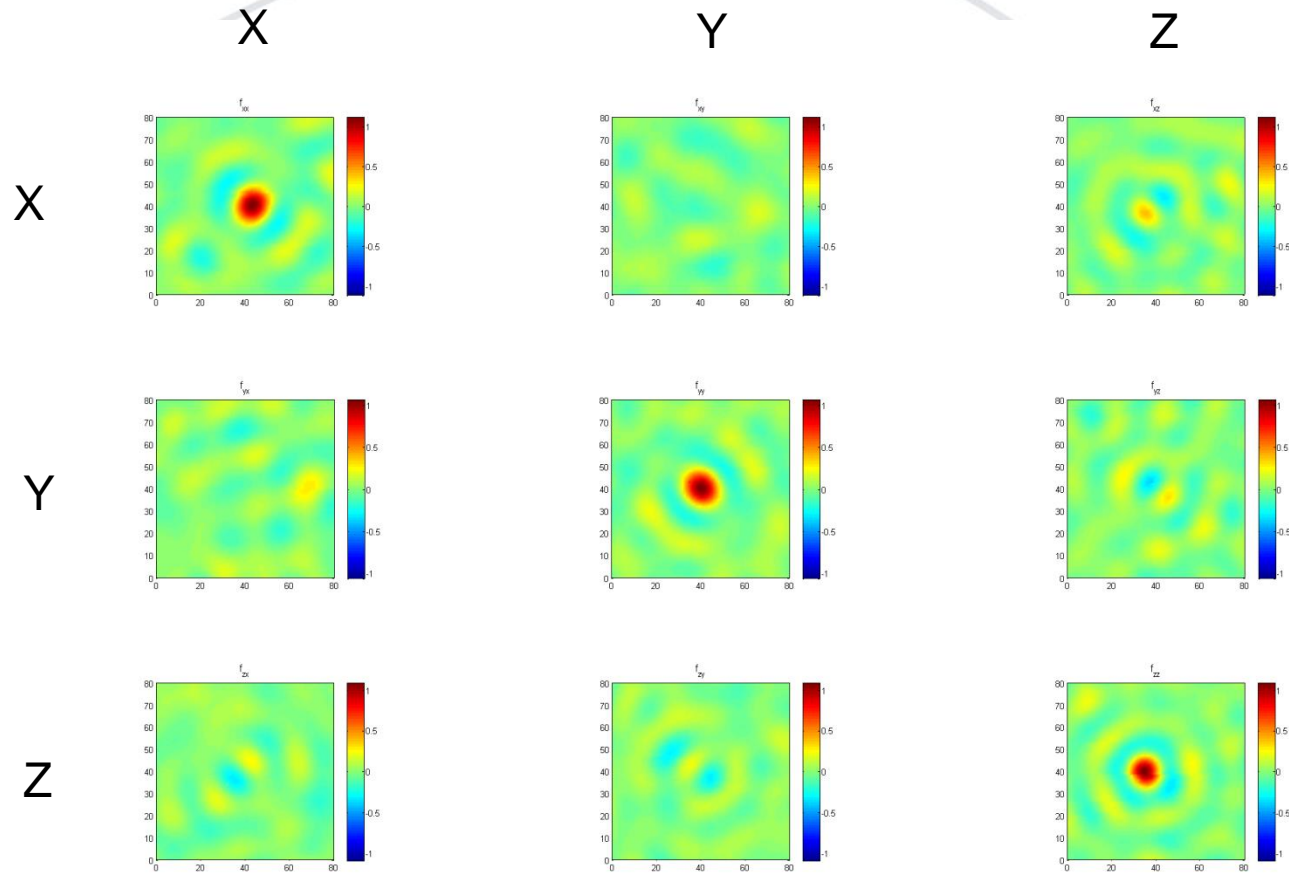
Setup and sample



Defects:

Cracks
Delaminations

Selected component focus



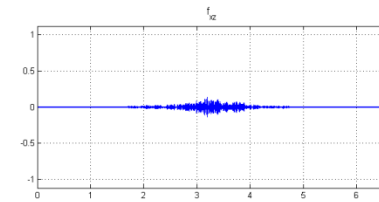
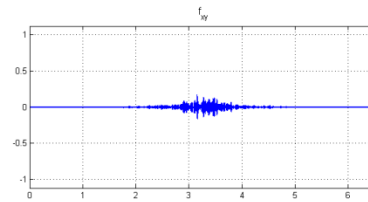
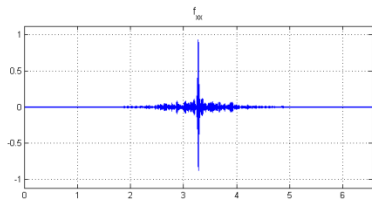
Selected component focus

X

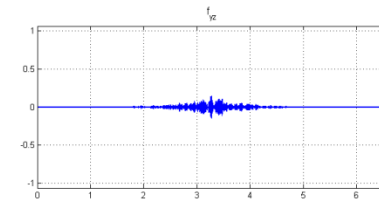
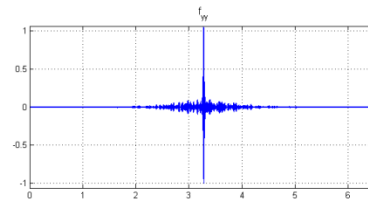
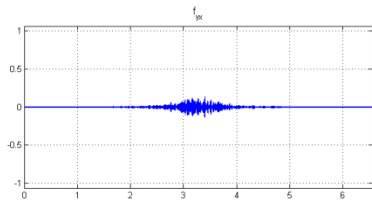
Y

Z

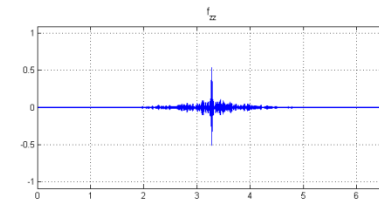
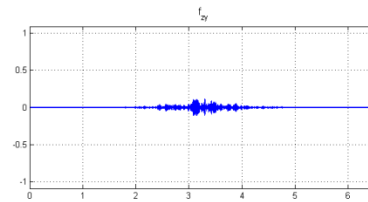
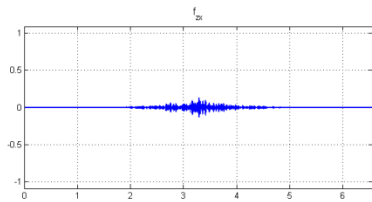
X



Y



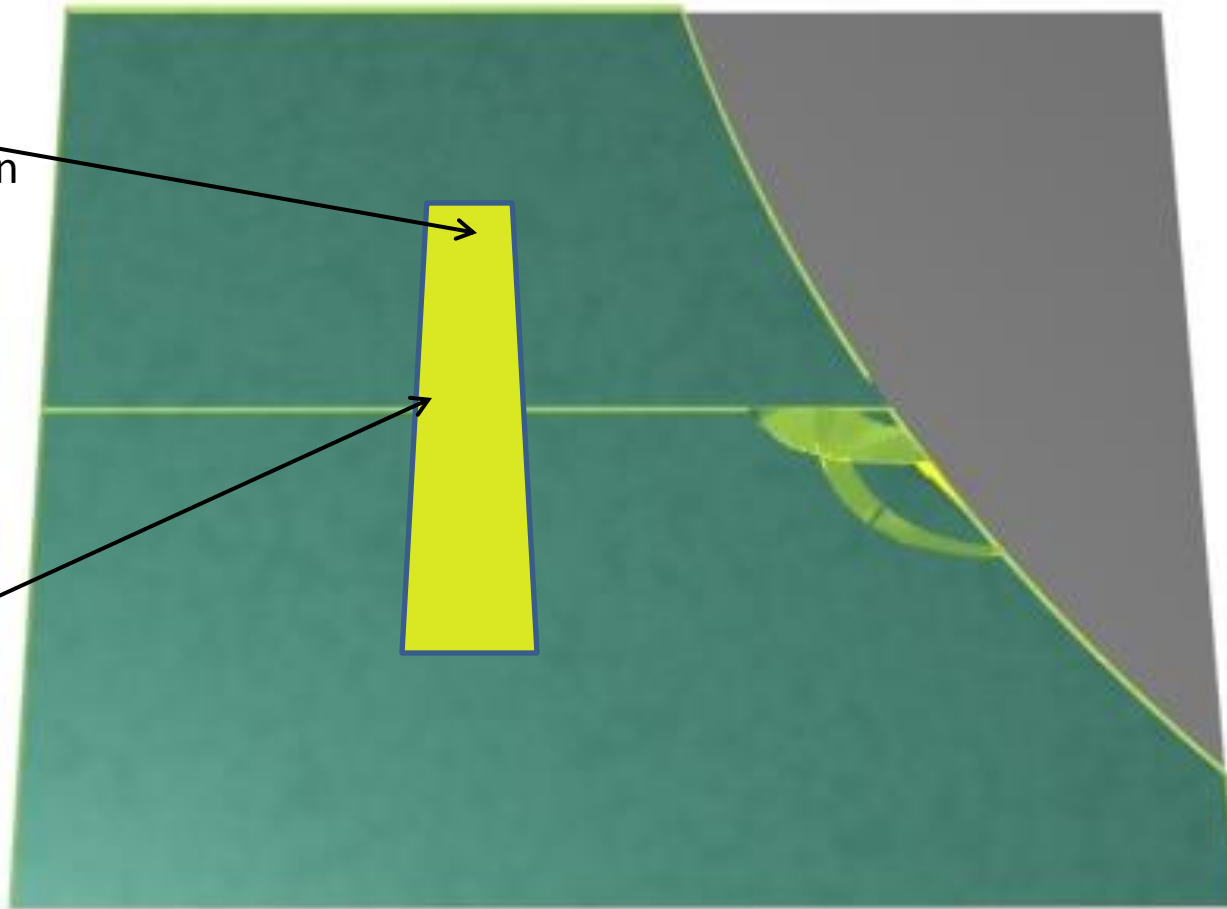
Z



Scan area

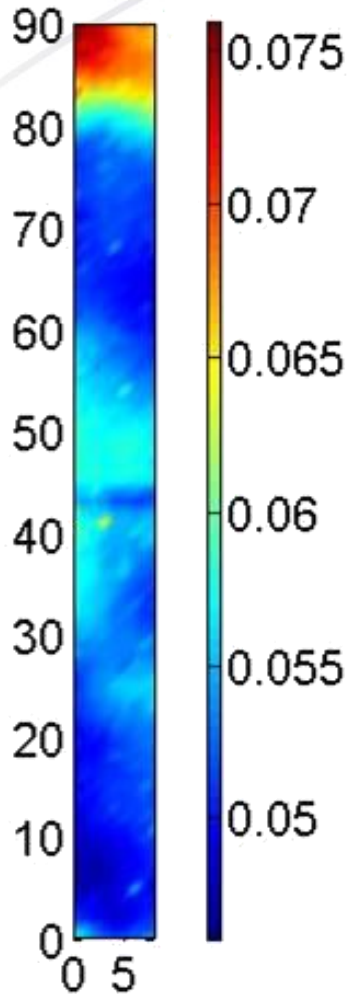
delamination

crack

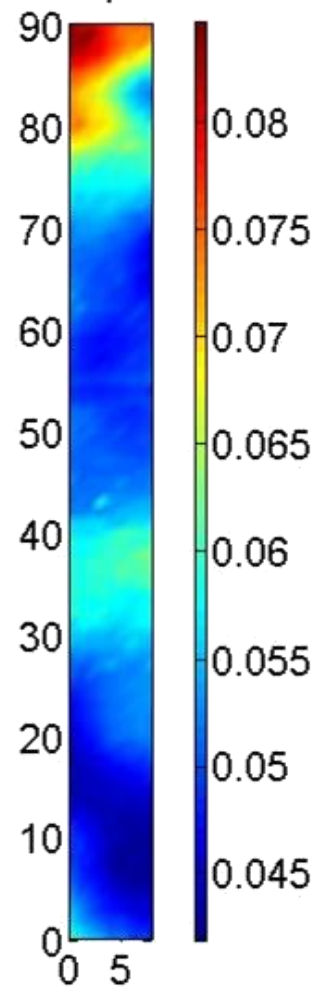


Linear image 75kHz

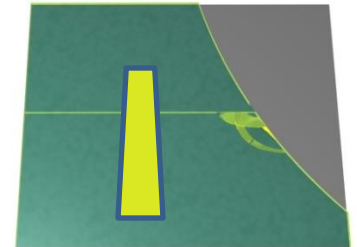
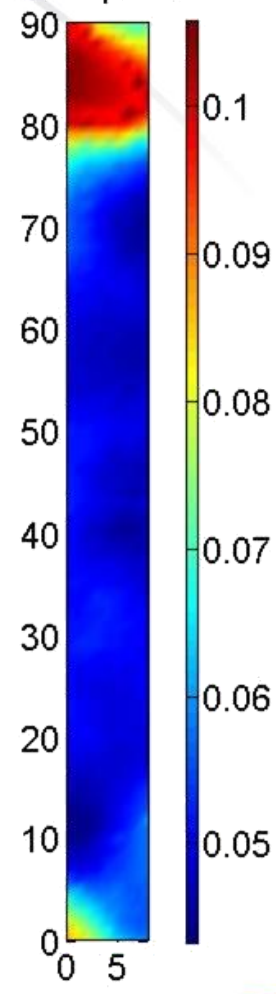
X component



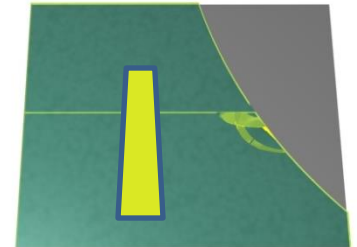
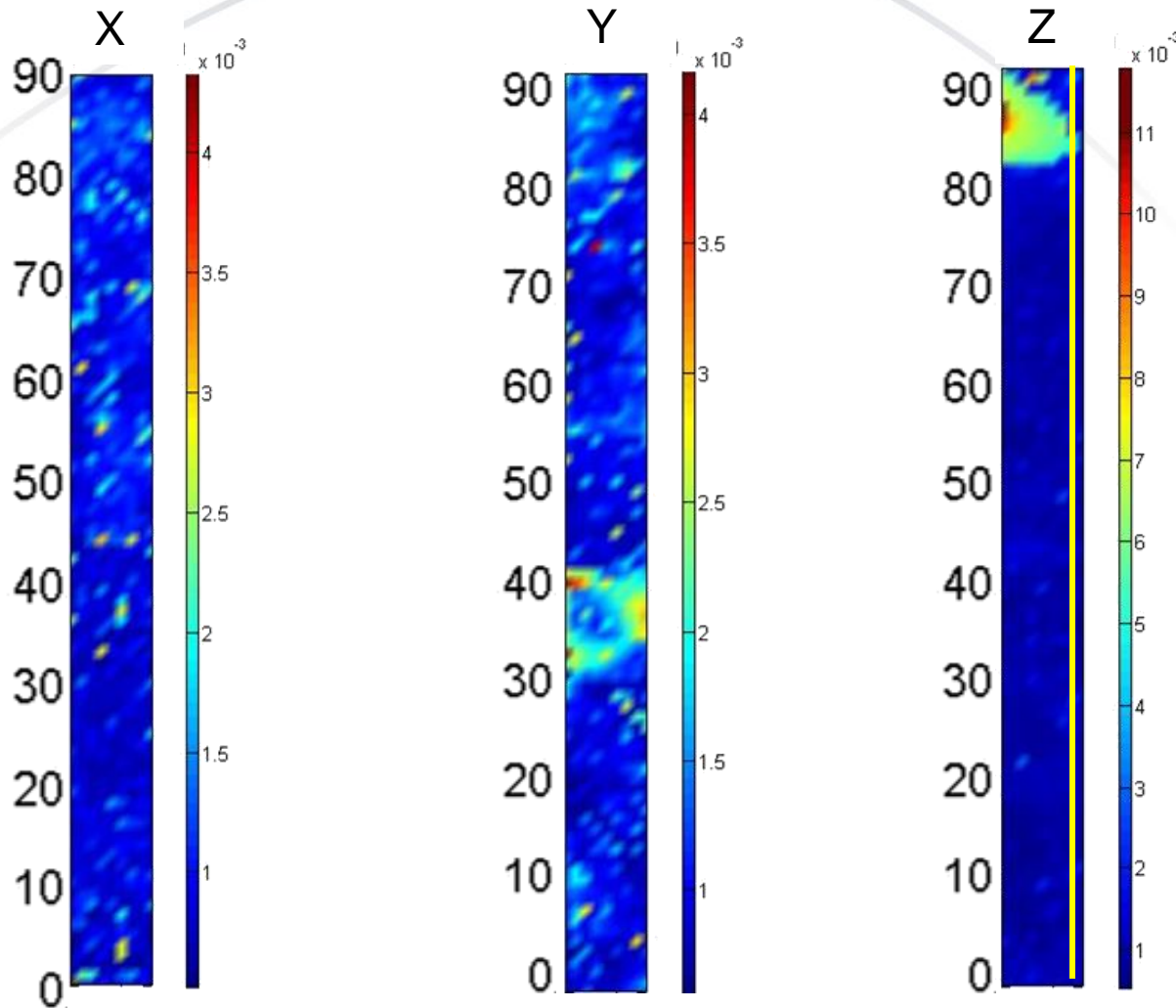
Y component



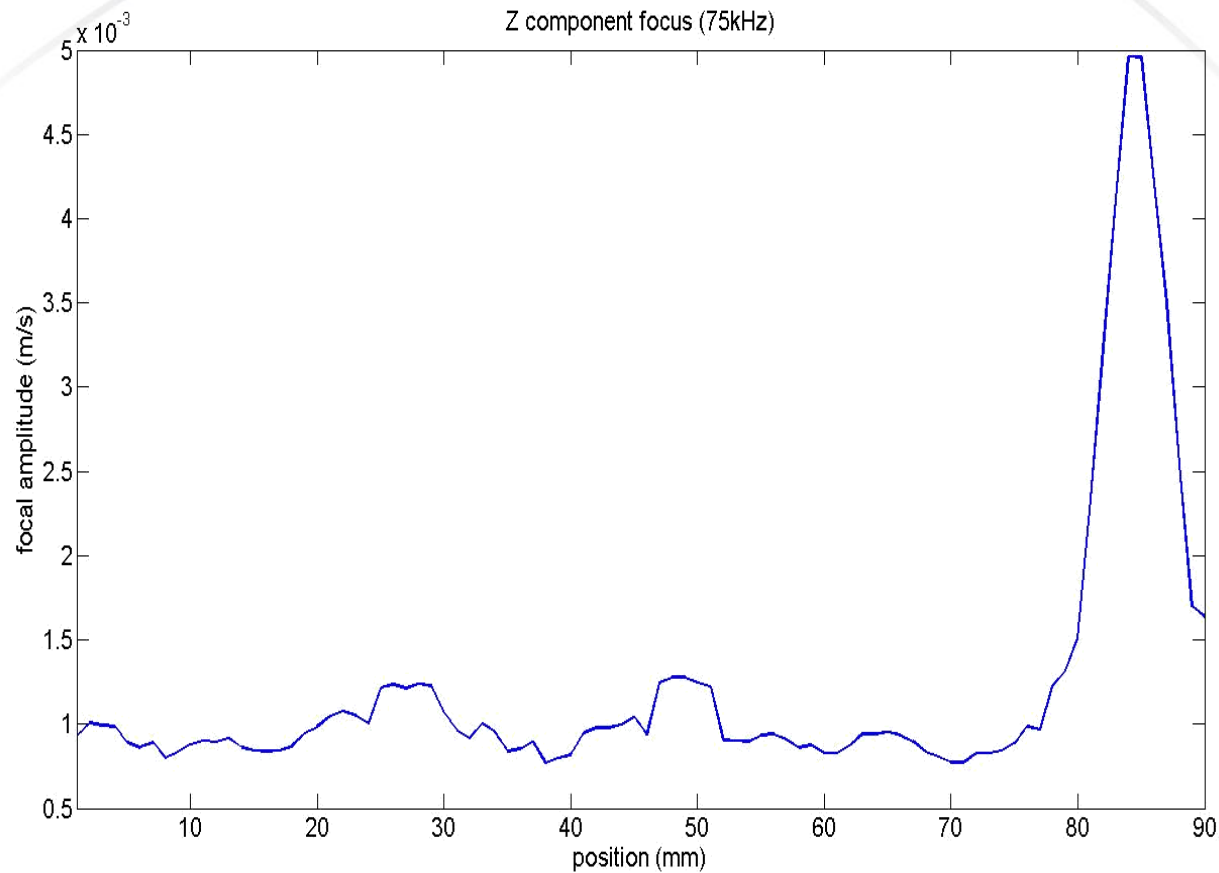
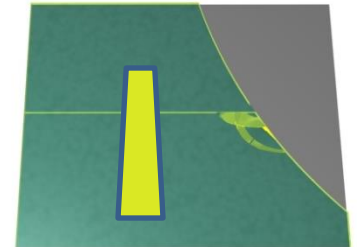
Z component



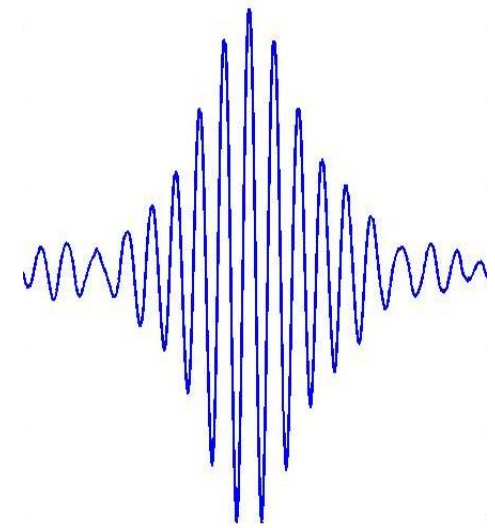
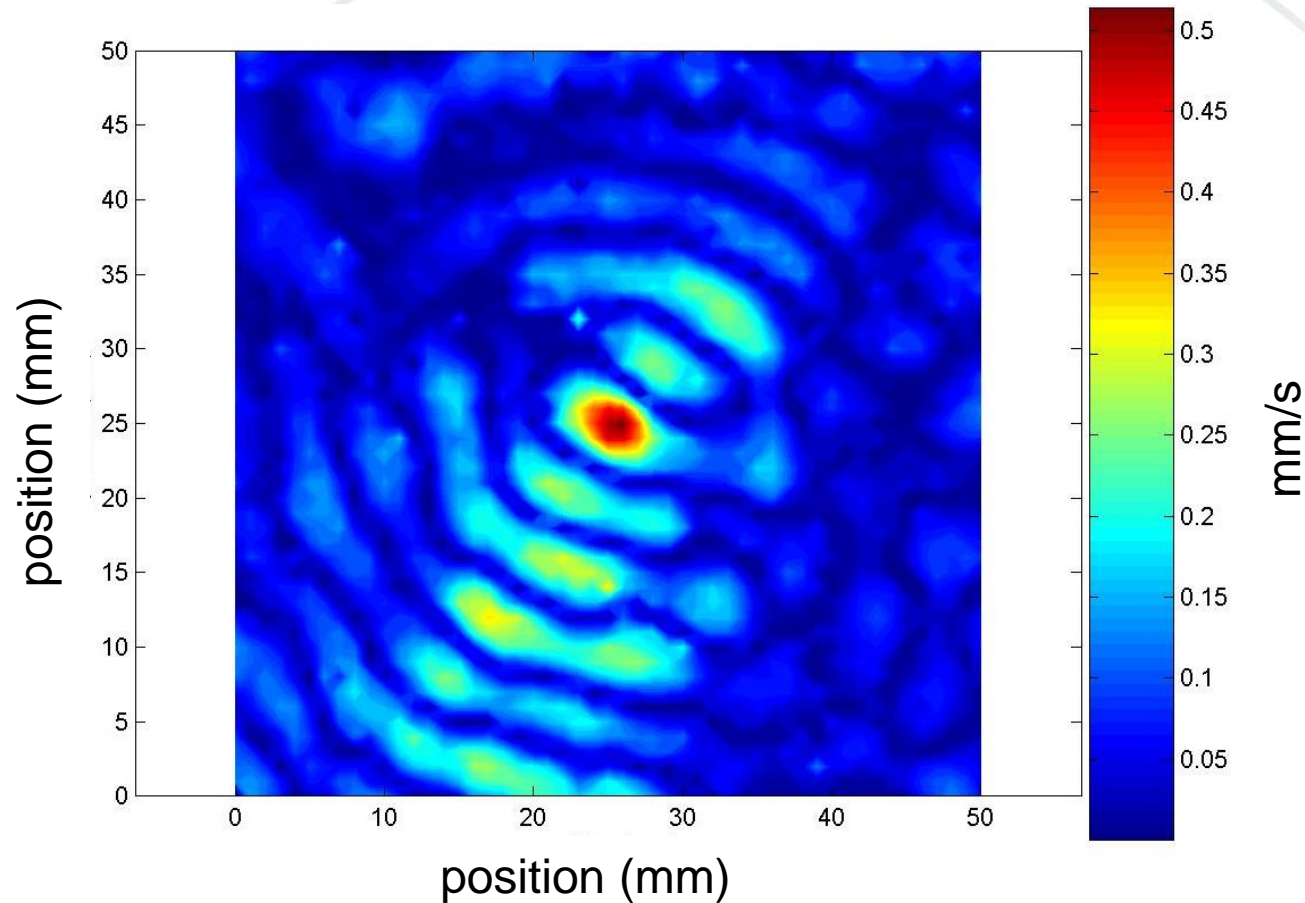
Nonlinear image 75kHz



Nonlinear image 75kHz



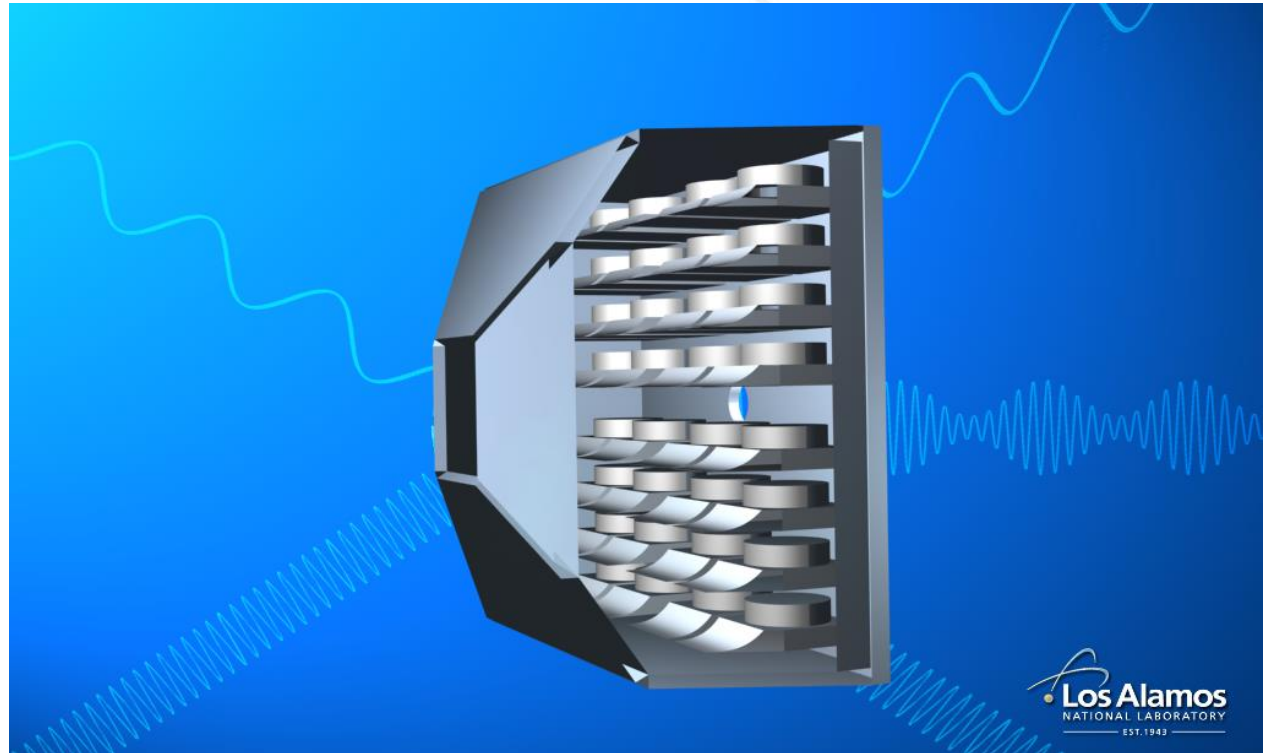
Multi-component focusing (in-plane result)



Path forward

New prototype to be tested

- 32 transducers
- Profile to optimize energy transfer to air
- Automated calibration

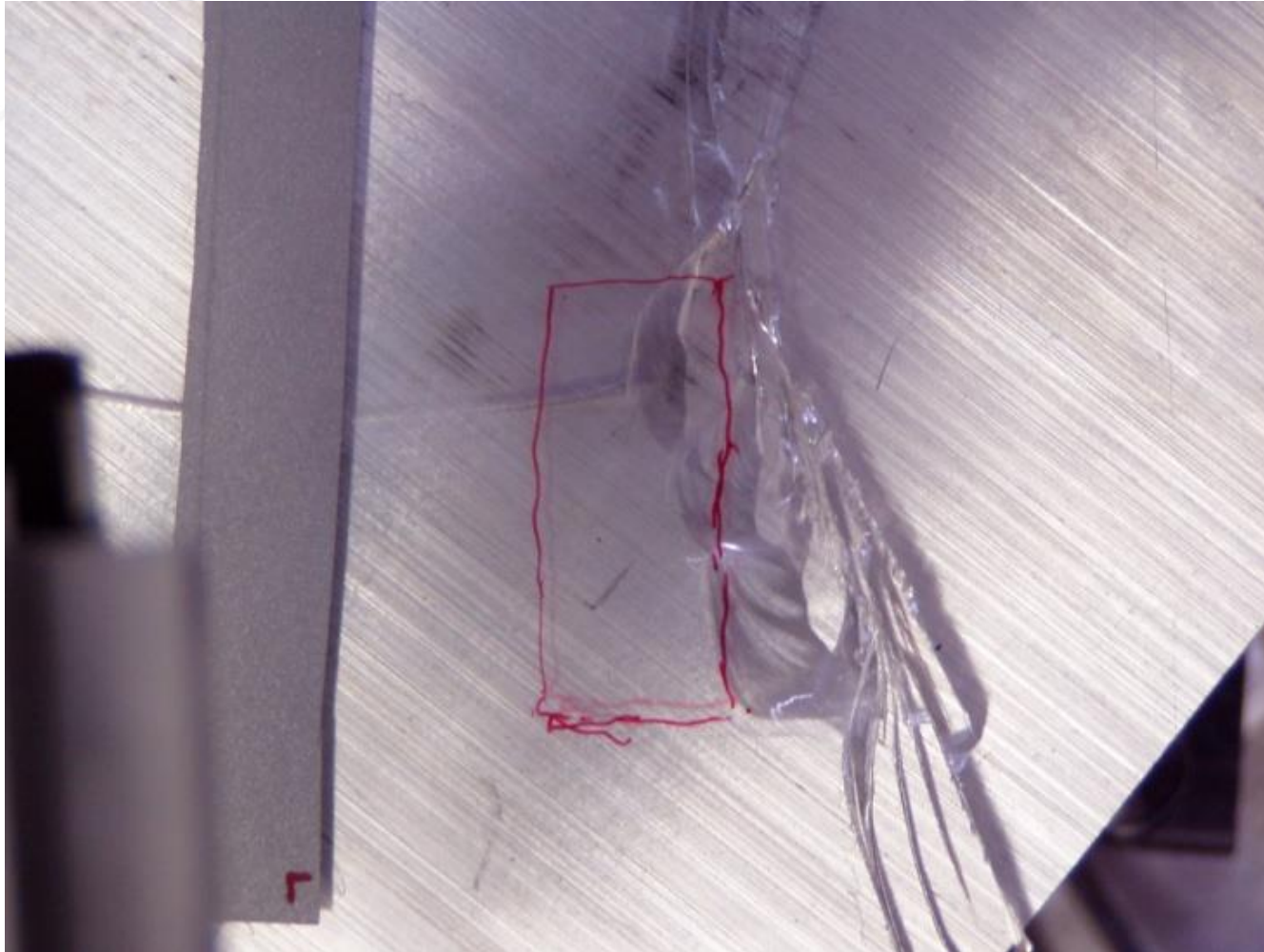




Backup slides

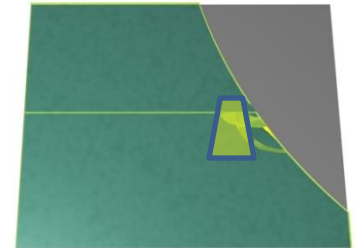
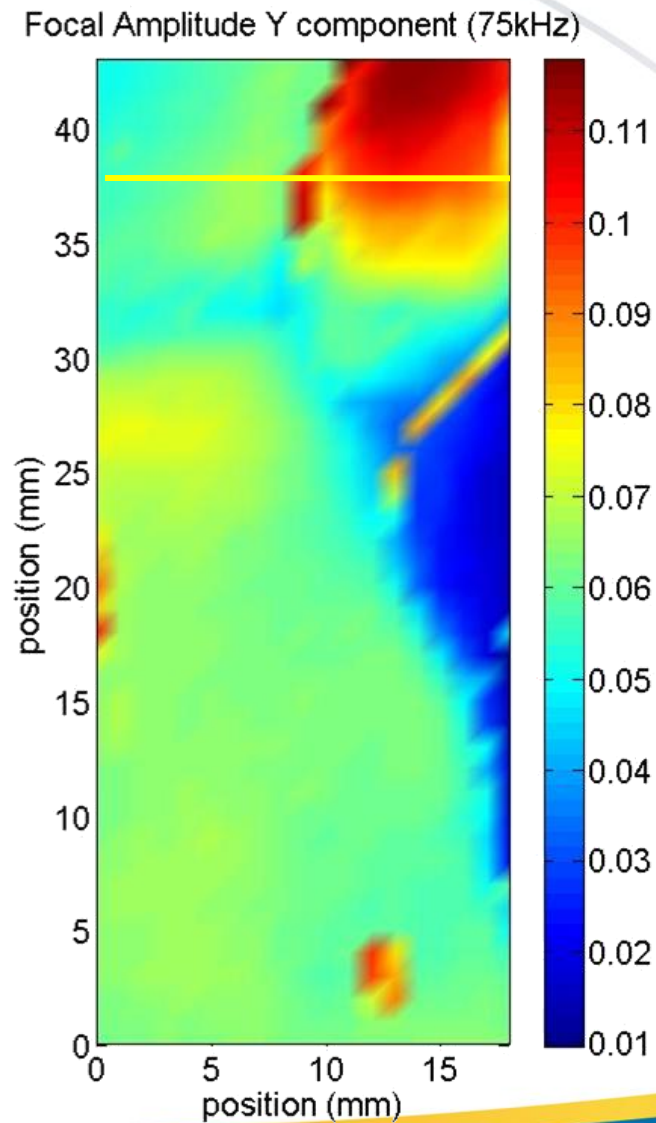
UNCLASSIFIED

Scan area 2

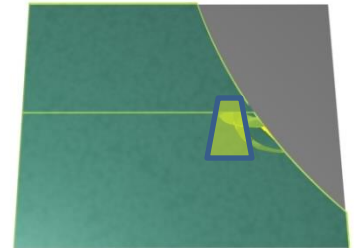
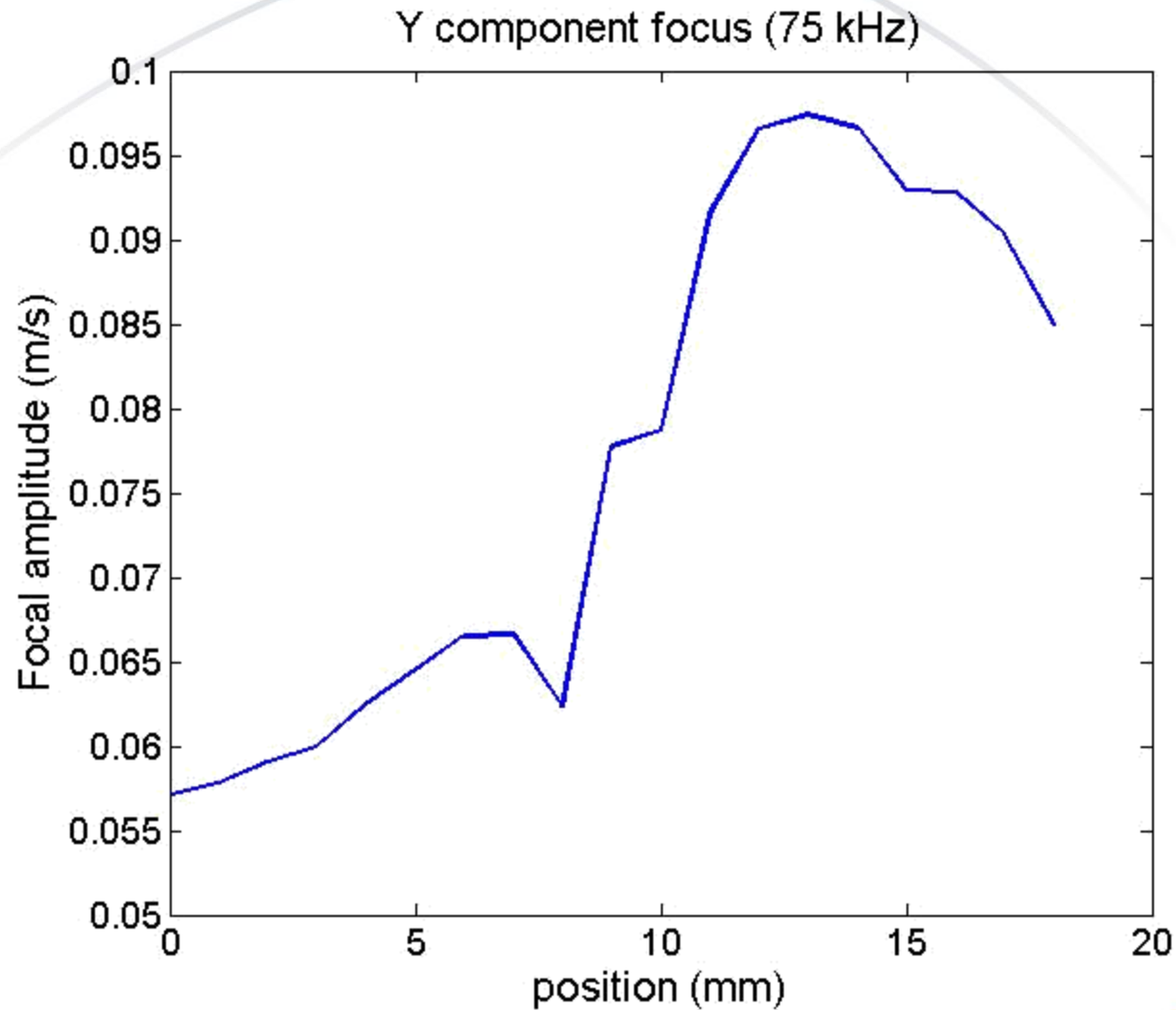


cracks

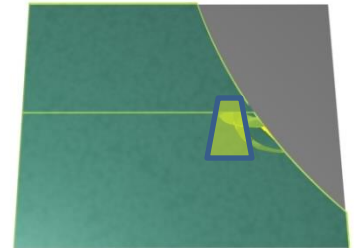
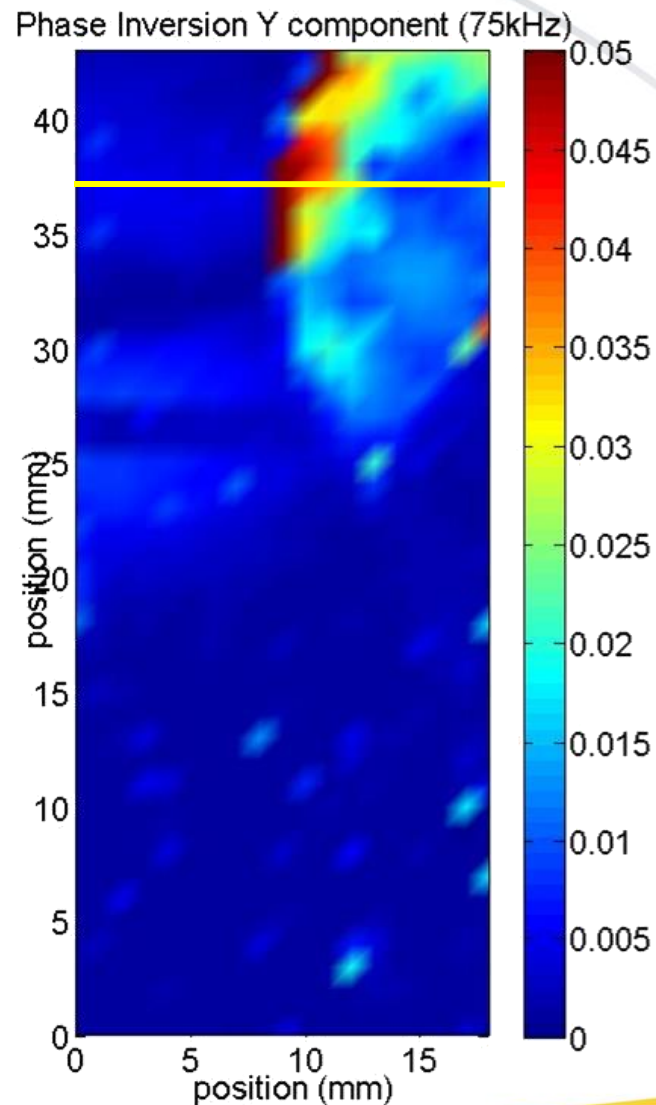
Linear image



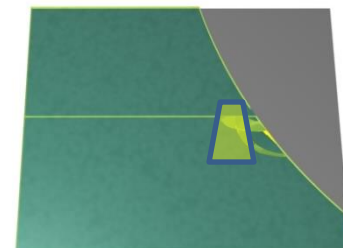
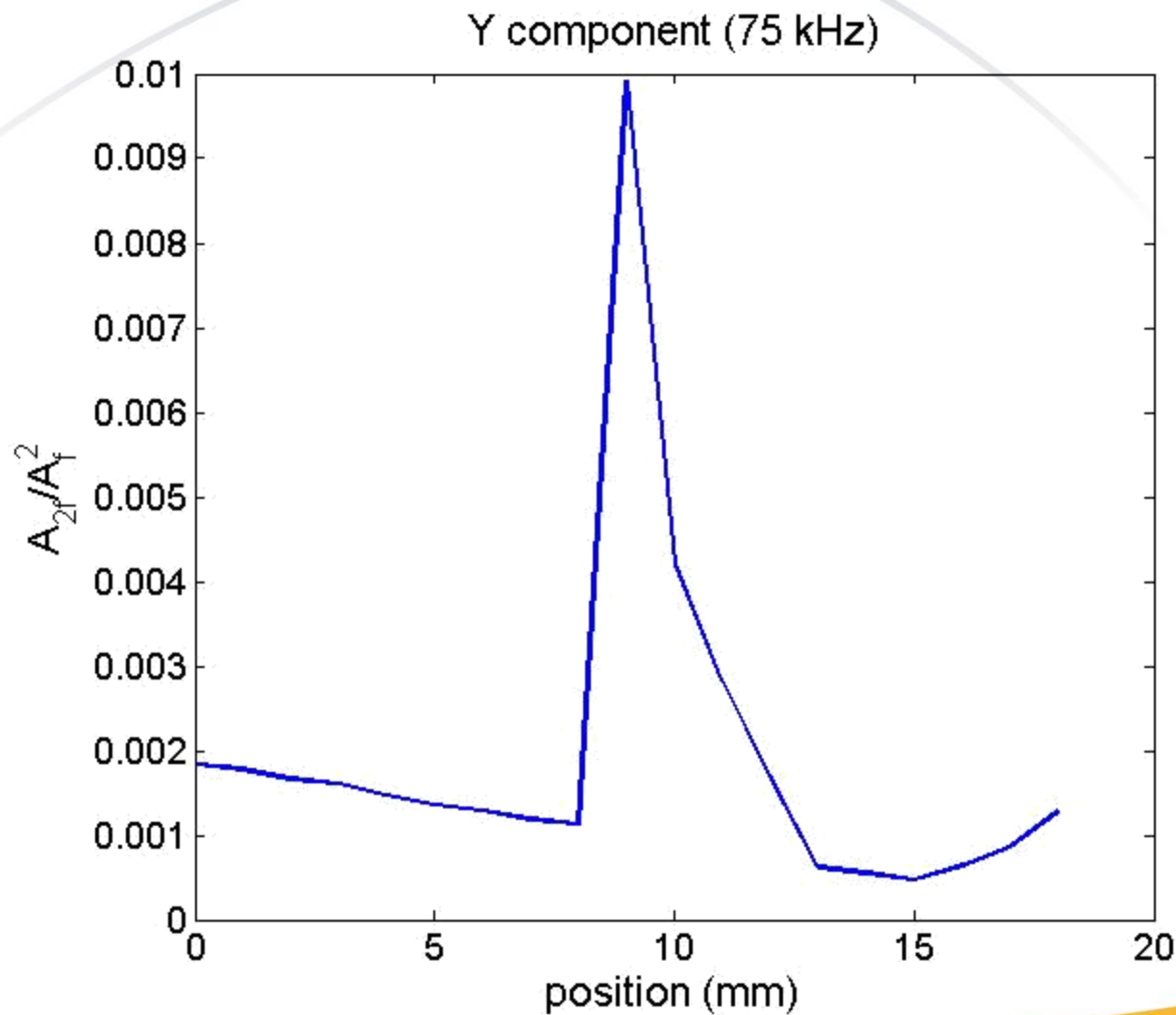
Linear image



Nonlinear image



Nonlinear image



Selected component focus

